INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

LLS-9000 SERIES

This manual provides instructions intended for the operation of the Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to all LLS-9000 series models unless otherwise specified.

LAMBDA ELECTRONICS MELVILLE, N.Y.

MAIN PLANT TELEPHONE: (516) 694-4200

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IM-LLS-9000

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SPECIFICATIONS AND FEATURES

(Specifications apply for all models)

DC OUTPUT — Voltage and Current regulated for line and load.

TABLE 1

VOLTAGE AND CURRENT RATINGS

MODEL	VOLTAGE RANGE (volts)	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE			
		40°C	50°C	60°C	70°C
LLS-9008	0 to 8	100A	90A	78A	57A
LLS-9018	0 to 18	45A	40A	33A	25A
LLS-9040	0 to 40	20A	18A	15A	11A
LLS-9060	0 to 60	14A	12A	10A	8A
LLS-9120	0 to 120	7A	6A	5A	4A
LLS-9300	0 to 300	2.8A	2.4A	2.0A	1.6A

Current range must be chosen to suit appropriate ambient temperature.
Current ratings apply for entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation (line) ..... 0.05% of Vo(max) for input changes from 85 - 132 or 170 - 265 volts AC.

Regulation (load) ..... 0.05% of Vo(max) from 0 to full load.

Ripple and noise ..... 5 millivolts rms, 35 millivolts peak-to-peak on models LLS-9008 and LLS-9018.
(20 MHZ measurement bandwidth)

10 millivolts rms, 75 millivolts peak-to-peak on models LLS-9040 and LLS-9060.

20 millivolts rms, 150 millivolts peak-to-peak on model LLS-9120 and LLS-9300.

Overshoot ..... No overshoot at turn on, turn off or power failure.

REGULATED VOLTAGE OUTPUT (Cont'd)

Negative Offset Voltage	Power supplies are shipped from the factory with minimum output calibrated to 0 +/- 10 millivolts. Internal calibration is available to achieve up to -0.1V negative offset, if desired.
Temperature Coefficient	0.03% per degree C.
Stability (drift)	0.1% per 8 hour period after 30 minute warmup.
Remote programming:	
External Resistor	Adjustable from 1000 ohms per volt to 200 ohms per volt (Rp terminal to -V). Except 300V model, available as 1000 ohms per volt only.
Programming voltage	One to one voltage change (RP terminal to -V).
	Zero to 5 Volt signal from RVP terminal (TB202-2) to Common terminal (TB202-6) programs output from 0 to Vo(max). (Common terminal is approximately at the same potential as +V)
Remote Sensing	Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

REGULATED CURRENT OUTPUT (AUTOMATIC CROSSOVER):

Regulation (line)	0.3% Io(max) for input changes from 85 - 132 volts AC or 170 - 265 volts AC.
Regulation (load)	0.3% Io(max) for output voltage changes from Vo(max) to short circuit.
Current range	Specifications apply for 5% to full load current.
Voltage range	As shown in Table 1.
Ripple	1% Io(max) - rms.
Remote programming	Zero to 5 V signal from RCP terminal (TB202-4) to Common terminal (TB202-6) programs output from 0 to Io(max). (Common terminal is approximately at the same potential as +V.)

AC INPUT

Line voltage	85 - 132 volts AC (47-63Hz) or 170 - 265 volts AC (47 - 63Hz) via rear panel selector switch.
Input power	1100 watts max.
Input RMS current	17.5 Amperes max.

AC INPUT (Cont'd)

Efficiency	72.5% minimum on 8V model, 75% minimum on 18 and 40V models, 77.5% minimum on 60, 120V and 300V models; at full output power.
Input surge protection	Meets IEEE 587-1980 for branch circuits and outlets (class A).
Inrush limiting	Power-up inrush current will not exceed 40 Amps peak.
EMI	Conducted spectrum conforms with requirements of FCC Docket 20780 Class A (85-132 VAC input) and VDE 0871 Class A (170 - 250 VAC input).

PARALLEL OPERATION - LLS-9000 units of the same rated output voltage can be paralleled in a master/slave arrangement.

SERIES OPERATION - LLS-9000 units of the same rated output voltage can be connected in series with auto-tracking so that both units will track to a common reference.

OVERLOAD PROTECTION

Thermal	Internal airflow sensing circuit shuts down unit's operation if air inlet blockage or fan rotor lockup occurs. When a thermal shutdown occurs, the main oscillator's operation will be terminated and all internal bias supplies, and the fan, will shut down. In addition, a front panel fault indicator light will turn on. AC power must be removed for approximately 60 seconds to reset the shutdown circuit.
Electrical Input	20A/250V Normal Blo fuses F101 and F102 protect AC input circuitry. 10A/250V Normal Blo fuse F103 protects printed circuit board from damage in the case of internal component failures.
Output	Automatic constant-current-limiting circuit limits the output current to a customer adjustable value (0% to full load), thereby providing protection for the load as well as the power supply. In addition, there is an internal inverter peak-current-limit circuit which protects the power supply during load transients.

OVERVOLTAGE PROTECTION

All LLS-9000 models include a built-in adjustable overvoltage protection circuit which prevents damage to the load caused by excessive power supply output voltage. Exceeding the overvoltage set point will shut down the unit's operation and cause the front panel fault indicator to light up. AC power must be removed from the unit for approximately 60 seconds to reset the OV shutdown circuit.

Overvoltage Adjustability Range	Model LLS-9008:	4 to 11 VDC.
	Model LLS-9018:	4 to 24 VDC.
	Model LLS-9040:	8 to 50 VDC.
	Model LLS-9060:	8 to 70 VDC.
	Model LLS-9120:	20 to 130 VDC.
	Model LLS-9300:	55 to 330 VDC.

REMOTE TURN-ON / TURN-OFF - A TTL low signal (0 to 0.5V), or a short, between Remote on/off terminal (TB202-5) and common terminal (TB202-6) enables the output. A TTL high (2.8 to 5V), or open circuit, between the Remote on/off terminal and the common terminal will bring the output voltage to zero.

COOLING - Forced-air cooling using ball-bearing, long-life fan (no lubrication needed). Fan draws air in through front portion of chassis and exhausts air through perforations at rear of unit. Leave adequate clearance at all air intake and exhaust openings.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE - Continuous duty from 0 to 71°C ambient with corresponding load current ratings for all modes of operation and appropriate derating.

STORAGE TEMPERATURE (Non-operating) -- -55°C to +85°C

INPUT / OUTPUT CONNECTIONS

AC input	Two-terminal, heavy-duty recessed terminal block with cover. Accepts No. 8 ring-or spade-type lug. Line cord should be chosen to be compatible with maximum expected ambient temperature of application.
Line safety ground	No. 8-32 tapped hole and screw in chassis by AC input terminal block.
DC output	8- and 18-volt units: Bus bars. 40-60-120-volt, and 300V units: heavy duty printed-circuit-board-mounted terminal block with clear plastic cover.
DC sensing, Remote voltage programming, Remote current programming, Remote on/off, Remote resistance programming, Parallel operation	Rear panel, printed-circuit-board-mounted lugless connector (TB 202 - 13 positions).

CONTROLS

DC output	Numerical keypad on front panel allows adjustability of either constant voltage or constant current limit points. Resolution of programmed voltage: 10mV on models LLS-9008 and LLS-9018; 100mV on models LLS-9040, LLS-9060, LLS-9120 and LLS-9300. Resolution of programmed current: 1A on model LLS-9008;

CONTROLS (Cont'd)

DC output (cont)	
	100mA on models LLS-9018, LLS-9040, LLS-9060 and 10mA on model LLS-9120 and LLS-9300. Accuracy of programmed value versus delivered output: ±2% or 3 counts, whichever is greater.
Standby Control	Allows for zero output without losing last programmed values for voltage and current.
On/Off Switch	Rocker switch located on front panel.
Overvoltage control	Multi-turn, screwdriver-adjust potentiometer located on front panel.

METERS - Front panel 3 1/2 digit voltmeter and 3 digit ammeter simultaneously monitor output voltage and current. Accuracy of metered value versus delivered output: ±2% or 3 counts, whichever is greater.

CONSTANT VOLTAGE/CONSTANT CURRENT INDICATORS - Located on Front Panel. These displays indicate whether power supply is operating as a constant voltage source or is in current limit.

MOUNTING - One mounting surface. Mounting position not restricted.

PHYSICAL DATA

Size	4-9/32" x 8" x 12-7/8"
Weight	14.5 lbs net; 19 lbs shipping
Finish	Light Gray, FED.STD.595, No 26622

ISOLATION RATINGS

Input to output	3000 Volts rms
Output to ground	500 Volts rms
Input to ground	1500 Volts rms.

WARRANTY - 3 years, parts and labor.

ACCESSORIES

Rack Adapter system	LRA-15, -17, -18.

Rack mounting kit.

Cable system.

Lambda MATE or GPIB systems.

OPERATING INSTRUCTIONS

CONTROLS, FUSES AND INDICATORS

Front Panel On/Off Switch. Located on front panel is an On/Off switch which controls the application of input power to the supply. The switch activates an internal relay which, when the switch is in the off position (labeled "O" on the switch), disconnects the input circuit from both sides of the AC line.

Front Panel Programmer. The front panel numerical keypad serves to program both the constant voltage and constant current limit points. Starting with the most significant digit, keying in the desired value followed by an "ENTER" keystroke will institute a new operating limit for either output voltage or current limit, as determined by the programming mode indicators. The programming mode can be switched from voltage to current via the "VOLTAGE/CURRENT" key which functions as a pushbutton toggle.

During a new programming key-in sequence, the front panel digital meter will present the keyed-in value of voltage or current until the "ENTER" key is depressed. Once this occurs, the meter will revert back to measurement mode and present the output voltage or current delivered by the supply. In the event of a programming instruction not being followed by an "ENTER" command, the meter will automatically revert back to measurement mode after approximately ten seconds. The value of the non-entered programming instruction is then lost and any new programming instructions must be started from the most significant digit onwards. At any point during a programming instruction key-in, the meter can be reset back to measurement mode and the programming instruction discarded by depressing the "C/E" key.

If an entered programming instruction is not compatible with the rated output voltage or current of the power supply, the appropriate meter will display an "Err" message and the program instruction will not be carried out. Depressing the "C/E" key, or waiting approximately ten seconds, will reset the meter back to measurement mode.

At any time during operation of the power supply the programmed value of voltage or current can be displayed by momentarily depressing the "ENTER" key. This will change the appropriate front panel meter, as denoted by the programming mode indicator, to display the last programmed value for voltage or current for a period of approximately two seconds. After this time the meter will automatically revert back to measurement mode. Care should be exercised when performing this check so as not to depress the "ENTER" key for more than one second for this will institute the "Slew Down" function, as described below.

The output voltage or current limit points can be ramped up, or down, by utilizing the "Slew Up" or "Slew Down" arrow controls. Depressing the "Up" arrow will cause the output voltage or current (as denoted by the programming mode indicator) to ramp up at a rate which will increase with the length of time that the key is depressed. Similarly, depressing the "Down" arrow (which also serves as the "ENTER" key) will cause the programmed value for either voltage or current to decrease at a rate which will increase with the length of time that the key is depressed.

The output voltage of the supply can be brought to zero, without losing the last programmed values of voltage or current (which is the case when power is switched off), by utilizing the "STANDBY" key. Depressing the "STANDBY" key once will bring the output voltage to zero. Depressing the "STANDBY" key a second time will reinstate the last programmed values of voltage and current. Programmed values of either voltage or current can be changed while the unit is in standby.

Operating mode indicators. Included on the front panel are a pair of Operating Mode indicators which report on whether the power supply is operating as a constant voltage source, or is in current limit. If the output current of the supply is below the programmed value for constant current, the operating mode indicator under the voltmeter will illuminate to indicate that the unit is not in current limit. If the load connected to the supply is of low enough impedance to draw a current which reaches the programmed current limit point, the unit will crossover into constant current and the operating mode indicator under the ammeter will illuminate.

Fault Indicator. Also included on the front panel is a "FAULT" indicator which will illuminate if either an overvoltage or airflow interruption shutdown occur. When the fault indicator illuminates, all other displays on the panel will go dark.

Overvoltage Control. This is a multi-turn, screwdriver-adjust potentiometer located on the front panel. Rotation of this control will vary the overvoltage limit-point from the minimum specified value (fully CCW) to the maximum specified value (fully CW).

Fuses F101, F102. These are 20A/250V Normal-Blo fuses located in series with the hot line. These fuses protect the power supply from excessive overcurrents in the event of an internal component failure. NOTE: POWER SHOULD BE REMOVED FROM THE UNIT BEFORE ANY CHECKING OR REPLACEMENT OF FUSE IS ATTEMPTED.

Fuse F103. This is a 10A/250V normal-blo fuse located in series with the main inverter current path. This fuse protects printed circuit board traces in this circuit in the event of an internal component failure. NOTE: POWER SHOULD BE REMOVED FROM THE UNIT BEFORE ANY CHECKING OR REPLACEMENT OF THIS FUSE IS ATTEMPTED.

Line Select Switch S101. This is a screwdriver actuated switch which is accessible through a hole in the rear of the unit. Selection of input voltage range (85-132 or 170-265 VAC) should only be performed with AC power removed from unit.

CONNECTIONS

AC Input. AC input connection should be made using a line cord compatible with maximum expected voltage, current and ambient temperature. Wires should be terminated with No. 8 ring or spade lugs.

DC Output. Load connections must be made to output bus bars (8- & 18-volt units), or to two-position terminal block TB201 (40- through 300-volt units). (This block is designed to handle the maximum current and voltage attainable from the supply and will accept a No. 8 Ring-or Spade-type lug.)

Sensing. Terminals for sensing output voltage are located on TB202, and are terminals 10 and 12. Local sensing can be achieved by strapping terminal 10 to terminal 11 (connects to +V) and terminal 12 to terminal 13 (connects to -V). See figure 3.

Remote Voltage Programming, Remote Current Programming, Remote On/Off, Remote Resistance Programming, Parallel Operation. Terminals for achieving these functions are located on TB202, pins 1 through 9. See modes of operation and operating procedures for details. TB202 is a lugless-type connector which will accept up to an AWG No. 20 stripped wire. Shipped with the unit are a number of ring-type solder lugs which can be utilized if multiple wires are to be connected to TB202 positions.

Load Ground Connection. This power supply can be operated with either the positive or negative terminal grounded, or with neither terminal grounded. The line safety ground tapped hole in the chassis at the rear of the unit can be utilized for grounding one of the output terminals, if desired.

> NOTE: When operating the supply with neither output terminal grounded, high impedance leakage resistance and capacitance paths can exist between the power supply circuitry and chassis ground.

BASIC MODES OF OPERATION AND OPERATING PROCEDURES

This power supply is designed to operate as a constant-voltage source or as a constant-current source. Automatic crossover to either mode of operation occurs when load conditions change as follows:

Constant Voltage. The power supply will function as a constant-voltage source while the load current is less than the current value I_{LIM} as set by the front panel current-limit programming generator, or, where applicable, by the external current programming signal applied to the RCP terminal. When the load current I_L ($=Vo/R_L$) reaches I_{LIM}, the supply will crossover automatically and will operate as a constant current source. Further decrease in the value of the load resistor will result in a decrease of voltage across the load while the current remains regulated to I_{LIM}.

Constant Current. The power supply will function as a constant-current source while the load voltage V_L does not exceed the voltage value set by the front panel constant voltage programming generator, or, where applicable, by the external programming signal applied to either the RVP terminal or the Rp terminal. When the load resistance is high enough so that the load voltage Vo ($=I_L \times R_L$) reaches the value set by the programming controls, the supply will automatically crossover and operate as a constant voltage source.

Power Up and Front Panel Initial Settings. Upon initiation of AC power, the front panel constant voltage and constant current generators will be preset to deliver zero output voltage along with a current limit point corresponding to the 40°C rating of the supply, plus 2%. Immediately following power on, the front panel meters will display these programmed values for approximately two seconds before reverting to measurement mode.

To deliver voltage after power up, the desired operating voltage must be entered through the numeric keypad, or the "Slew Up" arrow can be utilized. It should be noted that when the power supply is switched off via the front panel switch, the last entered programming values of voltage and current will be lost. When the power supply is switched back on again, it will power up as described above. If an application requires that power be interrupted to a load, and a quick return to the pre-existing programmed values of voltage and current is desired, the front panel "STANDBY" control can be utilized.

OPERATION AS A CONSTANT-VOLTAGE SOURCE

The output impedance and regulation of the power supply at the load may change when using the supply as a constant-voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing can be used. Recommended types of supply-load connections, with local or remote sensing, are described in the following paragraphs.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for applications with relatively constant load where extremely close load regulation over the full rated current excursion is not required at the load.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drop in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A .5UF capacitor may be required between the output terminals and sense terminals to reduce noise pick-up.

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

CONSTANT-VOLTAGE OPERATION, INTERNAL PROGRAMMING, ADJUSTABLE CURRENT LIMIT

When shipped from the factory, the supply is ready for use as a constant-voltage/constant-current power supply with automatic crossover. Initial programmed points for constant voltage and constant current are as described in the previous text. Jumpers are in place for local voltage sensing, figure 3. If remote-sensing connection is desired, the load should be wired as shown in figure 4. It should be noted that the front panel voltmeter measures the voltage at the rear power terminals and may not accurately reflect voltage at the load in remote sense applications.

Determine load requirements and select wire size from figures 1 and 2.

After application of input power, output voltage can be adjusted to any desired value via the front panel numeric keypad programmer. The current limit point can be adjusted by setting the "PROGRAM" indicator to "AMPS" via the "VOLTAGE/CURRENT" key and then keying in the desired current limit value, followed by an "ENTER" keystroke.

Programmed Constant-Voltage Operation Using a Zero to 5-Volt External Source. The power supply output voltage can be programmed via an external zero to 5-volt source by utilizing the RVP terminal on TB202. The jumper between terminals TB202-1 and -2 should be removed and the external source connected between terminals TB202-2 and -6 (figure 5). Note that terminal 6 is at a potential slightly higher than that of +V and that any external source connected to terminal 2 must be electrically isolated from both +V and -V. Consult your Lambda sales representative or factory for applications which require remote programming from sources referenced to +V or -V. The constant-voltage operating point will be directly proportional to the external voltage, with zero output voltage corresponding to zero programming and rated output voltage corresponding to 5 volts programming. Remote versus local sensing and current limit set point adjustment are explained in the preceding text.

Programmed Constant-Voltage Operation Using An External Resistor. The power supply output voltage can be programmed via an external resistor by utilizing the Rp terminal on TB202. The external resistor should be connected between TB202 terminal 9 and -V, while the -S terminal (TB202 terminal 7) is not connected (figure 6).

On the LLS-30 through LLS-9120 models, the value of the external resistor can be chosen to either 200 ohms per volt (nominal) or 1000 ohms per volt (nominal) by presetting the voltage from TB202-2 to common terminal TB202-6 via the front panel programmer. A 5-volt setting on these terminals corresponds to 200 ohms per volt (nominal) and can be

achieve[illegible]og[illegible]ing the front panel to full scale voltage (Vo(RATED)+2%). A 1-volt potentia[illegible]ec[illegible]e terminals corresponds to 1000 ohms per volt (nominal) and can be achieve[illegible]og[illegible]ng the front panel to 20.4% of the rated voltage. It should be noted that this pr[illegible]ned v[illegible] must be re-entered every time AC power is applied to the power supply.[illegible]hat 300V models, a 5-volt potential between these terminals corresponds to 1000 oh[illegible]vol[illegible]his is the only programming signal recommended for the 300V model.

In o[illegible]pr[illegible]any external shorting contact made between Rp and -V from seeing excessi[illegible]en[illegible]g a programming-down execution, an internal resistor is connected in series w[illegible]P[illegible]minal that limits the maximum peak current out of the Rp terminal to 1 Amp.[illegible]st[illegible]cause a small offset voltage to be present at the output terminals. This offset[illegible]ill[illegible]ge from approximately +0.05 volts on model LLS-9008, set at 200 ohms per vol[illegible]) 5 v[illegible]n model LLS-9120, set at 200 ohms per volt. The magnitude of this offset[illegible]car[illegible]imited by increasing the ohms-per-volt utilized in the application. For example[illegible]ode[illegible]S-9008, the offset becomes approximately +0.01 V, set at 1000 ohms per volt, an[illegible]node[illegible]3-9120 it becomes approximately +0.1 V, set at 1000 ohms per volt. Remot[illegible]lo[illegible]sing and current limit set point adjustment are as described above under Consta[illegible]g[illegible]ing procedures. For 300V models, offset will be approximately +.5V.

Progra[illegible]on[illegible]Voltage Operation Using a One-To-One External Voltage Source

Refere[illegible]V.[illegible]ower supply output voltage can be programmed via an external one-to-one vol[illegible]uti[illegible]the Rp terminal on TB202. The external voltage source should be connected[illegible]n R[illegible]minal (TB202-9) and -V, while leaving -S terminal (TB202-12) disconnected (figure 7).[illegible]ddition, terminals 7 and 8 should be open circuited.

The[illegible]hould be current limited to no more than 20mA in order to protect internal[illegible]the LLS unit.

In o[illegible]imi[illegible]urrents in the Rp terminal to approximately one amp during programming u[illegible]g[illegible]down transients, an internal resistor is included in series with the Rp termin[illegible]ote[illegible]s local sensing and current-limit-set-point adjustment are as described above under Const[illegible]Voltage operating procedures.

OPERATION AS A[illegible]STANT-CURRENT SOURCE

In t[illegible]on, when the load voltage increases, due to changing load resistance, to the l[illegible]h[illegible]el constant voltage setting, the power supply crossover circuit will cause t[illegible]it to o[illegible]as a constant-voltage supply.

SAFETY NOTICE

DANGE[illegible]O[illegible]S EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTI[illegible]NG OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

Consta[illegible]Internal Programming, Adjustable Voltage Limit. When shipped from th[illegible]s ready for use as a constant-voltage/constant-current source with automa[illegible]ove[illegible]rating points for constant current and constant voltage are as describe[illegible]in the pr[illegible]s text.

Determi[illegible]e load[illegible]ements and select wire size from figures 1 and 2.

Afte[illegible]g[illegible]tput current and maximum voltage limit point can be adjusted to any desi[illegible]alue v[illegible]ront panel numerical keypad.

Pr ing a -Current Operation Using a Zero-to-5 Volt External Source. The power su t c mit can be programmed via an external zero-to-5 volt source by utiliz- in P ter TB202. The jumper between terminals TB202-3 and -4 should be re nd th al source should be connected between terminals TB202-4 and -6 (figure 8) that is at a voltage slightly higher than that of +V and that any external so ne minal 6 must be electrically isolated from both +V and -V. Consult your L le ative or the factory for applications which require remote programming fr es d to +V or -V. The constant-current operating point will be directly pr l rnal voltage, with zero output corresponding to zero programming and f tp t at 40°C +2% corresponding to 5 volts programming. Maximum v t sc s as described above.

O OP ERATION

T e Turn-On/Turn-Off. A TTL compatible remote turn-on/turn-off func- ti zing terminal 5 of TB202. A TTL low signal (0 to 0.5 Volts) or a short b terminal 6 of TB202 enables the output voltage. A TTL high (2.8 to 5 V er etween terminal 5 and terminal 6 of TB202 will cause the output voltage to , s 9. It should be noted that terminal 6 (common) is at a voltage slightly hi n +V TTL signal must be electrically isolated from +V and -V.

P pe output current capability of LLS-9000 power supplies can be increased b f the same output voltage rating in parallel. The supplies can be opera- t E configuration by using the circuit shown in figure 10. The jumper b 8 of TB202 on the SLAVE unit must be removed, and a connection must b TB202-6 of the MASTER unit to terminal TB202-9 of the SLAVE unit. Ir uld be added between TB202 terminals 6 and 10 of the SLAVE unit. N ent specifications do not apply in parallel operation.

S oltage capability of LLS-9000 power supplies can be extended by series o supplies of equal voltage ratings. A maximum of 500 volts can be c r the +V or -V terminal and chassis ground. Figure 11 shows the con- n peration.

D hich protect the units from carrying excessive current in the event of o ed up (i.e., fan not operational), must be capable of withstanding the m rat .

F ion with auto tracking, TB202 terminals 7 and 8 of the slave unit are d nother. Also, an external resistor, Rx, is connected from terminal T unit to terminal TB202-9 of the slave unit. The value of Rx is 1600 Ω f 0 Ω for model LLS-9018, 8000 Ω for model LLS-9040, 12,000 Ω for m Ω for model LLS-9120 and 300K Ω for LLS-9300. Due to the existence o e value of Rx required for perfect tracking may vary slightly from the n re. In addition, Rx must be able to dissipate up to 0.04 watts on model L model LLS-9018, 0.2 watts on model LLS-9040, 0.3 watts on model L nodel LLS-9120, and 0.3 watts on model LLS-9300.

U eatures and Implications on Output Noise. When various remote f pply are utilized (such as remote voltage programming, remote current p L compatible on/off or remote resistance programming), or when p ed in parallel or series combinations, output ripple and noise may be

slightl … -frequency spikes caused by noise radiated thru wires connected to
termi … ally, the amplitude and spectral content of these spikes is such that
a smal … connected at the remote load-distribution-point will adequately
attenu … However, in extremely sensitive applications, where spikes cannot
be tol … emanating from wires connected to terminals 1 through 9 can be
minim … y uti… frequency-rated ferrite noise suppressors on each of the externally
conne … nal … der to be effective, these noise suppressors must be physically
locate … si… a point no further than 3 inches from where the wire connects to
the pc … ly … These noise suppressors can either be obtained from your local
Lamb … of… ntacting the factory. Figures 15 and 16 detail the use of these
noise … ss

These … … to the unit for the +S and -S terminals and no external suppressors
are re … l to m… se radiation while using remote sensing.

ADJU … T C … ANEL OVERVOLTAGE CONTROL

The o … … rcuit provides an adjustable means of shutting down the power
supply … put … exceeds a pre-determined safe value. In the event of an over-
voltag … do… power oscillator is disabled along with all output bias supplies and
the f… ly … indicator light will turn on to indicate a fault condition. Once the
cause … e ove… been determined and removed, the shutdown circuit can be reset
by re… ; AC p… e unit for approximately 60 seconds.

The p … … overvoltage control is as follows:

(The … … emoved from associated equipment, be at an ambient temperature
of 25… and … nominal line voltage.)

1. … r … tage protection point is 115% of the selected power supply opera-
ting … or … e the selected operating voltage, whichever is greater. (If set too
low, … f tra… cause the overvoltage detection circuit to trip.)

2. … ntrol fully clockwise.

3. … e unit and adjust the output voltage to the desired protection
point … e p… s not have adequate output range to reach this point omit steps 4
and 5 …

4. … djust control CCW while monitoring the output voltage. When
the f… … l … and the front panel fault indicator light comes on, the OV
shutd … t h… hed.

5 … point is now set. Remove power from the unit for approximately
60 se… o re… own circuit. When power is switched back on, the initial
prog… l po… ge and current will be as described under POWER UP and FRONT
PAN … l …

6. … e po… djustment range is not adequate to reach the desired OV protection
poin… …

… … supply output to the normal operating voltage.

the OV adjust control R501 CCW until the front panel meters go dark
ar t ront r light comes on.

  chart below, select the appropriate volts/turn ratio and turn the OV
a the number of turns equivalent to 15% of the operating voltage (or
1. whi ter) to bring the OV set-point to the proper value.

	NOMINAL VOLTS PER TURN (R226)
	0.7
	2.1
	4.3
	6.2
	11
	22.5

O ON A TECTIVE DEVICE SHUTDOWN

Th u ermal shutdown circuit will activate if any interruption to normal
co . as a blocked air inlet or fan rotor lockup). When a thermal shut-
do urs llator circuit will be inhibited, thereby bringing the supply output to
ze . l fault indicator to light. In order to reset the unit after a thermal
sh . nd remove the cause(s) of airflow interruption, and then remove
po . least 60 seconds, if the unit has already cooled down. (If the unit is
no . wer for up to 2 minutes immediately subsequent to a thermal-
sh .

F . low w n the maximum rated current value for the fuses are exce-
ed tigue ses can occur when mechanical vibrations from the installation
co it uced stresses to weaken the fuse metal. Many fuse failures are
ca . ition and replacing the blown fuse will make the fuse-protected
ci .

N . moved from the unit before checking or replacing any fuse.

O . n the supply output increases above the overvoltage limit,
th . rcuit hut down the main oscillator's operation, thereby caus-
in tpu to zero. During overvoltage shutdown, front panel meters will go
dr he indicator lamp will be lit. After eliminating the cause(s) for
ov . ion of t wer supply by interrupting the AC input circuit for a
pe t lea s. (refer to TROUBLESHOOTING CHART).

AINTENANCE

GENI

T… …ble analy… …s routines, replacement procedures and calibration and
test p… …s t… …l for servi…ing this Lambda power supply. A trouble chart is
provi… …ai… …oleshooter. Refer to the section on SPECIFICATIONS AND
FEAT… …r… …ormance standards.

PERI…

T… …o… …ected fr… …associated equipment and inspected for dust accumula-
tion … …e… …Inspec… …ery six months or more often if operated in extremely
dusty … …t… …t the in… …ior of the unit, first disconnect AC input power to the
unit … …ver by … …moving the 6 screws securing the cover. If the unit
show… …t… …it should … …vacuumed clean in order to assure proper heat-sink
effic…

TRO… A…

W… …ystema… …lly check all fuses, primary power lines, external
circ… …t… …wirin… …malfunction before troubleshooting the equipment.
Failu… …n can … …aced to simple causes such as improper jumper and
supp… …ar… …e failu… …ue to metal fatigue.

U… …ar… …ic diagra… …and block diagram, figure 14, as an aid to locating
troul… …ic diagram… …ontains various circuit voltages that are averages for
norm… …io… …ese volt… …s using the conditions for measurement specified on
the s… …f… …easuri… …obes carefully to avoid causing short circuits and
dam…

CHF… …ND C… …ITORS

… C… …ar… …nstrum… …that has a highly limited current capability. Observe
prop… …N transi… …rs to avoid error in measurement. The forward tran-
sist… …ver zer… …ckward resistance is always higher than the forward
resis…

I… …ra… …orward… …stance for any junction is always greater than zero.

I… …ad… …liminate… …when only one part is replaced. This is especially true
whe… …ar… …ing other… …ransistors to fail. Replacing only one transistor and
turn… …king fo… …ditional defective components could damage the
repl…

V… …ser… …ctor de… …s, wherever possible, hold the lead being soldered with
a pa… …s… …een the c… …nent and the solder joint to provide an effective heat
sink…

…age resi… …nce obtained from a simple resistance check of a
…always … …dication of a faulty capacitor. In all cases
re shun… …with resistances, some of which have low values.
…rt is a t… …indication of a shorted capacitor.

f l not cov with solder, it is a good contact. Do not attempt to
c

nents can ade from either side of the board. Use a needle-point
p e wiring w er a protective coating is used on the wiring. A brass
p e an allig ip adapted to the measuring instrument.

h e, use a nk when soldering transistors.

ro print is usually the result of an imperfection, strain, or
c o e ir sm s, tin a short piece of hook-up wire to bridge the break,
a ce, flow r along the length of wire so that it becomes part of the
c

g compon m the board, never pry or force loose the part;
u by using king process described below:

16 inch th pper braid for use as a wick; if braid is not available,
s C 16 str e with 1/2 inch insulation removed.

) in liq lux.

k onto ldered connection and apply soldering iron onto the
w

ient a older flows onto the wick, freeing the component,
s ou iron and

ea ng w e-mount-technology parts, devices with two leads can
h pair s and a soldering iron first by heating both ends of the
solder i nd then by quickly removing the part with the twe-
nent fir s pre-wetting the mounting pads with a small amount
en holdin y part in place with the tweezers. First one end of the
nd then end is heated to the point where the solder melts and
art, th ing new solder joints. Care should be exercised to
.he par e of accidential overheating or mechanical stress.

ai of S , which have more than two leads is best left to SMT
ific d to handle removal and installation of these parts
ol and

T

end le for locating trouble causes and is used along with
t

a. he trouble chart are as follows:

r er v frequency is present at input terminals.

is c nnec nstant voltage with local sensing.

FETY NOTICE

I GE DU RGED CAPACITORS, MAY EXIST IN THIS EQUIP-
M I OBSERVE NORMAL SAFETY PRECAUTIONS
W

I

TRO OOTING CHART

	able Cause	Remedy
1. Z front maxi	with nt.)	t circuit across ut of supply	Check load connections. Correct as necessary.
Addit			
A. C on.	light	voltage fault	See manual section on procedure for setting OV adjust.
		mperature	Check for locked rotor on fan. Check for air inlet blockage.
B. F		ot program- perly	See manual section on procedure for programming front panel.
C. F 5 volt comm comm voltag to con	ed to	IC205 or defective. open.	Check and replace as necessary.
D. F 5V me to con 5V fro comm	RCP	307, 309, defective. 318, 320, en. C310, ed.	Check and replace as necessary. Check and replace as necessary.
E. F RVP o measu	not	panel uit at n/off TB202-5. IC215	See section of TROUBLE-SHOOTING CHART referring to front panel. Checkout wiring. Correct as necessary. Check and replace as necessary.
F. Fr	nal.	ble from nt con-	Check and repair as necessary.

TROU NG CHART (Cont'd)

		ible Cause	Remedy
Ze			
G. Ri	ional	panel try tive. 3 defective.	See section on TROUBLE-SHOOTING CHART referring to front panel. Check and replace as necessary.
H. to 5V O IC (re	CP e	1, IC202 ctive.	Check and replace as necessary.
I. in co	pt	llator circuit perational.	See below.
		7, 316, 319, tive.	Check and replace as necessary.
J. F1 No Q	ational. own. r	, 302, ctive, Q305 ed. D301 ctive.	Check and replace as necessary.
K. F		11, C105-C110 ed.	Check and replace as necessary.
L. bl		-304 cd.	Check and replace as necessary.
2. nc	f	sense lead.	Refer to appropriate connection diagram and correct as required.
3. to m	d	out of ation	Refer to CALIBRATION PROCEDURES in manual and recalibrate unit in the proper sequence.
4. do		3, 304, 305, -310 defective.	Check and replace as necessary.

BLESHOOTI G C RT - FRONT PANEL

		Cause	Remedy
1. Fro Power s running;		le from t panel ed.	Check and repair as necessary.
		le J602 con-	Check and repair as necessary.
Additio			
A. 5 v from pi (micro- TP2.			Check and repair as necessary.
B. 5 v pin 3 of		ctive.	Check and replace as necessary.
2. Pa to rate		y out n	Refer to CALIBRATION procedure and recalibrate unit in proper sequence.
		not operly	Refer to chart below for proper S601 settings.
		A C608 ifier)	Check and replace as necessary.
3. Par voltage		out	Refer to CALIBRATION procedure and recalibrate unit in proper sequence.
		not operly	Refer to chart below for proper S601 settings.
		A	Check and replace as necessary.
		ed nterface). ent fier), urement defective.	

NT PANEL I

ION - S601 SWITCH SETTINGS

M

1 BIT

	2		5	6	7	8	9	10
L	OFF		OFF	OFF	ON	OFF	*	*
LI 8	OFF		OFF	OFF	ON	ON	*	*
L)	ON	C	ON	OFF	ON	OFF	*	*
L	ON		ON	ON	OFF	OFF	*	*
L	OFF		OFF	ON	ON	ON	*	*

s 9 and 10 s
nt panel, w

or all models except during calibration of the
should be off.

P S

C ith o oltage Op
us test co n diagra
le btain results.
p nce

k the ripple and regulation of the power supply
e 12. Use suggested test equipment or equiva-
FICATIONS AND FEATURES for minimum

be chec
tage.
m
vs nd high li
e in the

the load from no-load to full-load while
an be measured by varying the input with a
rving the output voltage. Good technical judg-
t of test leads to minimize AC pickup.

d be mea
width osc
fields,
ltmeter

the power output terminals of the power
be used. In order to minimize pick up from
ground wire on the scope probe should be
UKE 8920A should be used to measure RMS

C ent
te shown
m tande

k the regulation of the power supply using the
er to SPECIFICATIONS AND FEATURES FOR

be
vo onitor
re d by v
ev suring
si tly l

g from a short circuit to a maximum output
rent via the current-measuring shunt. Line
line with a variac while monitoring the output
to measure the relatively small regulation
should be used.

fS rip
ac ring sh
be high fr

red by connecting a true RMS voltmeter
lter comprised of a resistor and capacitor may
s due to shunt inductance and pickup.

IN

POWE Y ON I

T calib ted within the LLS-9000 power supply:

nin)
nax)
in)
ax)
a
in)
in)

C alwa gether with that of R223. Calibration of
R204 f of R264. Calibration of R632 must always
be per. t o

B supply must be removed from associated
equipn . Unit must be wired in local sense with
intern from a nominal AC line.

Calibr -Ran nd R223.

1. tp upply, program the front panel voltage
progra

2. n external DVM, adjust R202 so that V_o is
betwe

esirable to have the minimum
volt chieved by adjusting R202 CCW
pu e desired value, with a -0.1V

3. el er for the rated output voltage of the
supply

4. out toned from +V to -V with an external DVM
indica -.01 volts.

5. with

Calibr -Ra t and R264.

1. output of ply, program the front panel current
progra

2. hr ent shunt connected across the output of the
supply.

3. rent measured via the external shunt is
betwe

grammer for the rated 40°C output current of the

ut current measured via the external shunt is the

t.

pply, set bits 9 and 10 of S601, located on front

r rated output voltage with no load connected at

ted by the front panel voltmeter corresponds with
put.

bits 9 and 10 of S601 to the ON position. Seal

x) measure R634.

pply, set bits 9 and 10 of S601, located on front

d connected at the output, monitor the voltage
e top of front panel P.C. Board F. Adjust R632
e P.C. Board F) so that the voltage between TP1
between +0.01 and -0.01 volts. Seal R632.

it terminals of the supply through a current

and rated current.

nted by the front panel ammeter agrees with that

9 and 10 of S601 to the ON position.

RVICE

r repair service is desired, contact the nearest
plete facilities are ready to assist you.

serial number together with complete details of
mbda will supply service data or advise shipping

ll be billed at cost and an estimate forwarded for

ORDERING

S id spec in the Lambda power supply can be obtained from t emer pare parts are available through any Lambda office

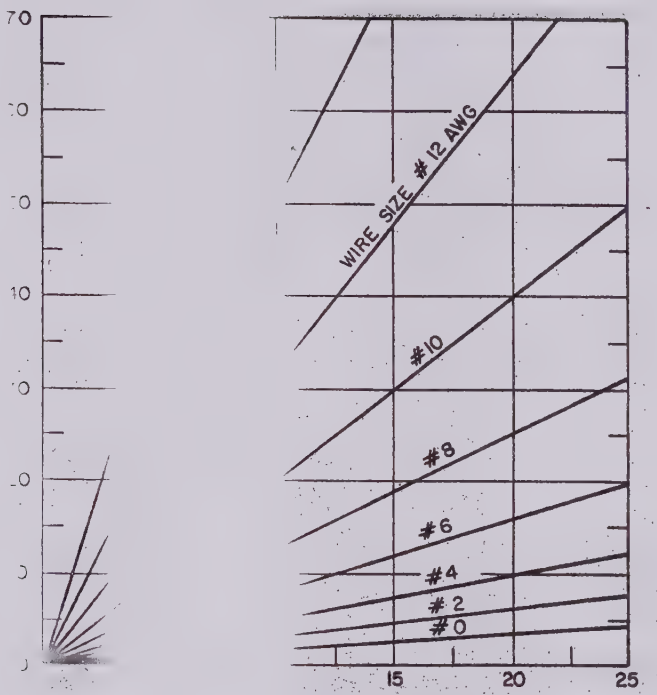
T n mus hen ordering parts:

1. serial n supply and purchase date.

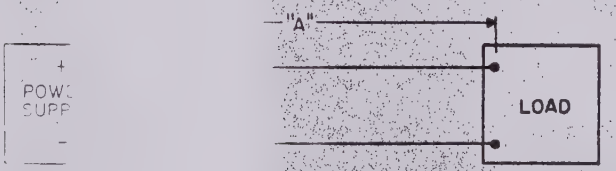
2 er.

3 toget designation.

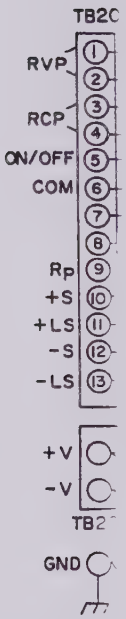
4 etron listed, provide a description, function and locati



Connection Chart.



ength "A" in Feet.

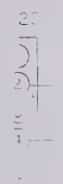


NOTE :
* FOR P
FROM -
+V T

Figure 3

, DISC
T JUMPER
T FROM

asin
ection



REMOT
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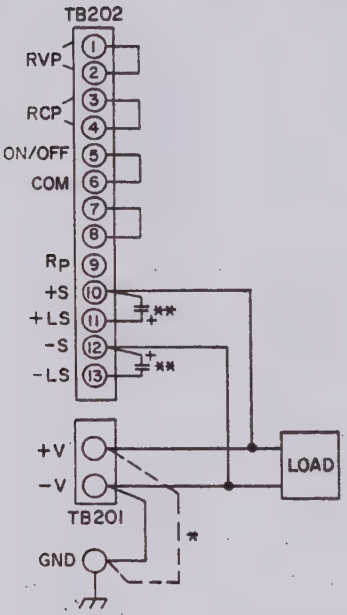
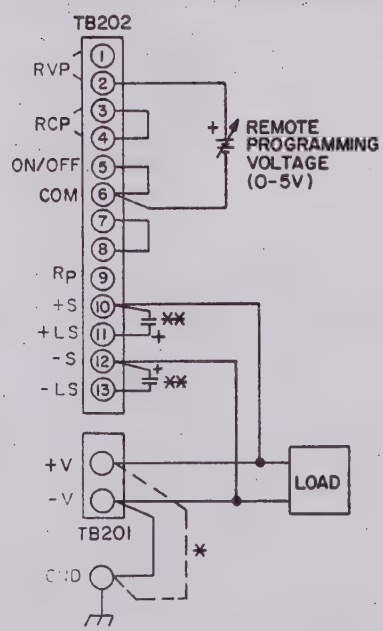


NOTE:
* FOR POSITIVE GROUND, DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.
** A 2.5MF, ELECTROLYTIC CAP. MAYBE REQUIRED.

Figure 4. Remote Sensing Connection.

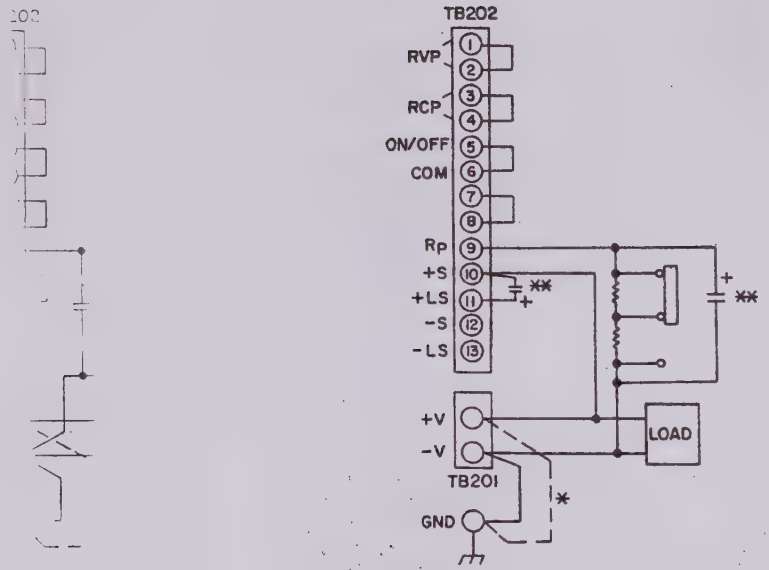


(B) REMOTE SENSING

MPER FROM -V TO GND AND

EQUIRED.

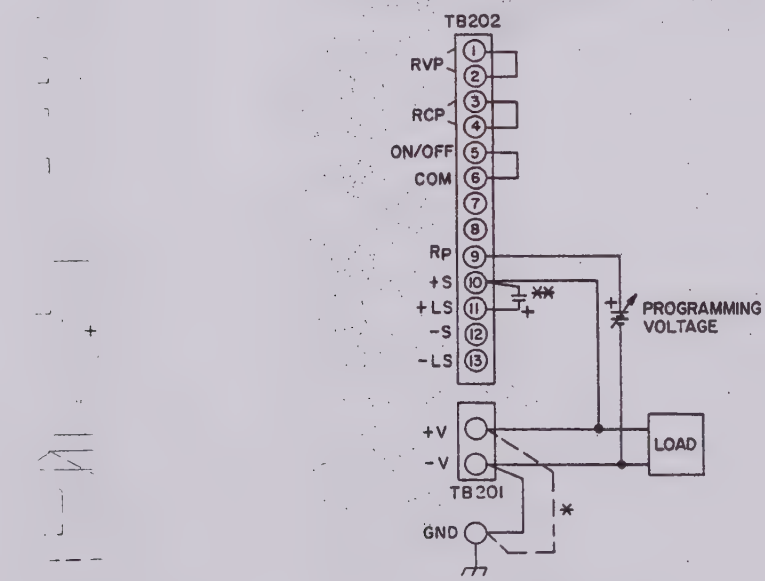
sing a **Zero to 5V External Source.**



(B) REMOTE SENSING

ONNECT JUMPER FROM -V TO GND AND
MAY BE REQUIRED.

Voltage **Using an External Resistor.**



(B) REMOTE SENSING

CT JUMPER FROM -V TO GND AND
MAY BE REQUIRED.

an **External Voltage Source Referenced to -V.**

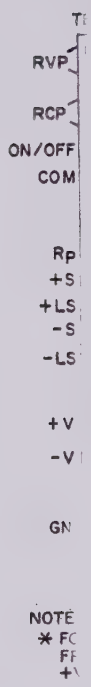
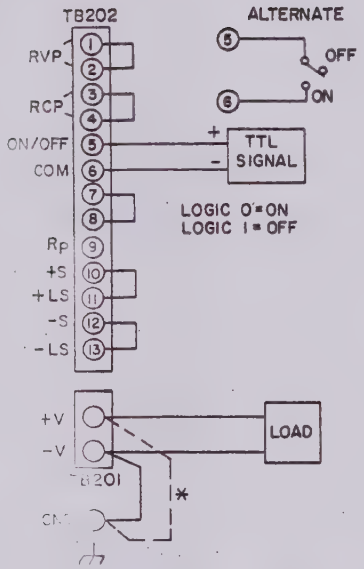


Figure 8.

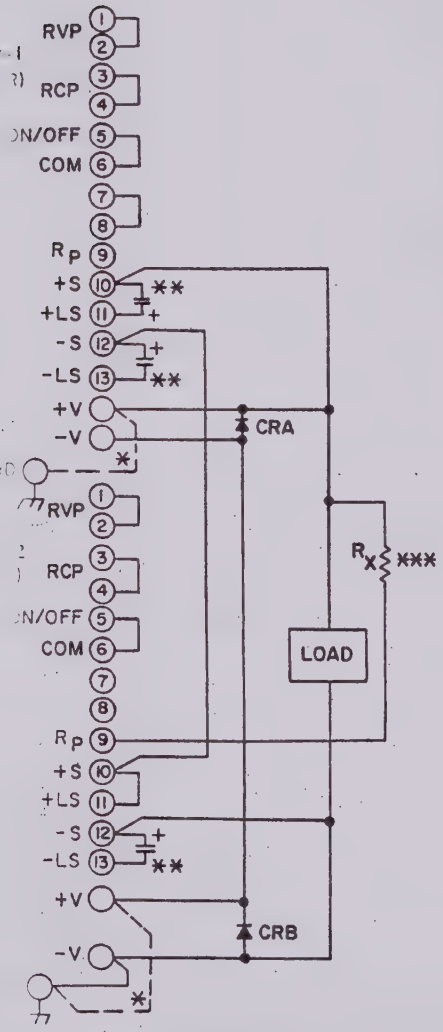


NOTE:
* FOR POSITIVE GROUND, DISCONNECT JUMPER FROM -V TO GND AND RECONNECT FROM +V TO GND.

Figure 9. TTL Compatible Remote On/Off.

SHOULD BE BALANCED
NT SHARING.

Operation.

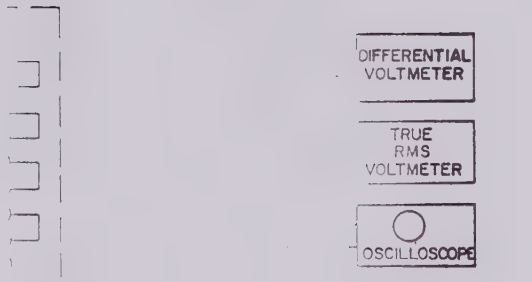


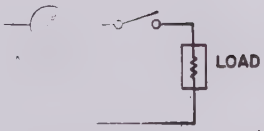
(B) REMOTE SENSING

ECTION FOR SERIES COMBINATION. TO CHANGE
UMPER FROM -V TO GND AND RECONNECT

AY BE REQUIRED.
ON FOR DETAILS OF R_X VALUES.

nection.





ITH LOCAL
N ONLY.
BE PERFORMED
UND, POSITIVE
UND.

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N TO DELIVER
ATED VOLT CURRENT.
PERFORMED
ID, POSITIVE

erformance Checks.

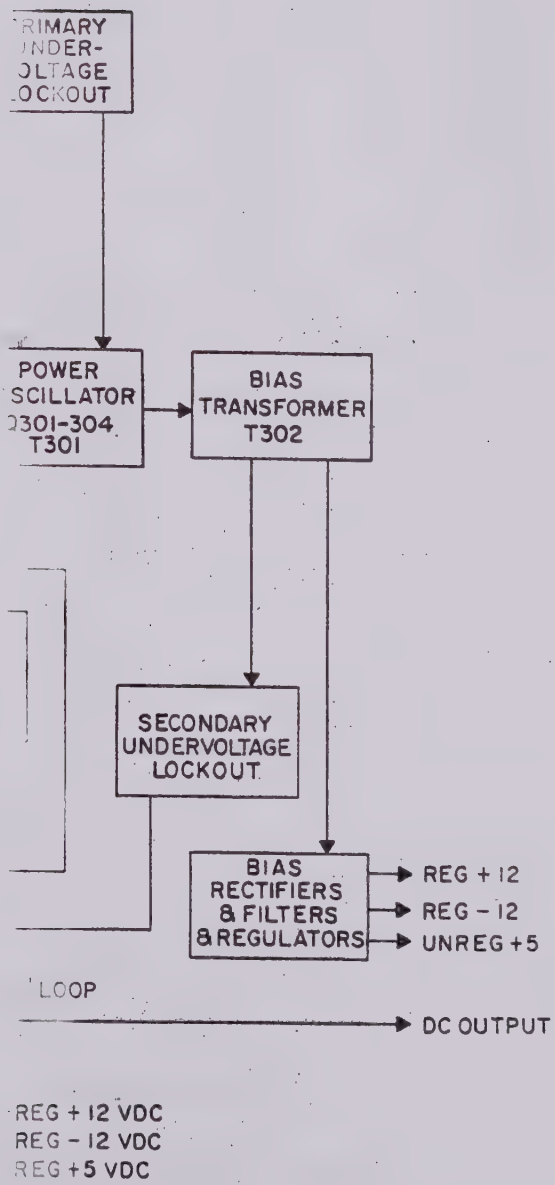
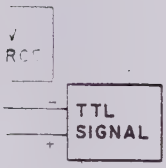

RIMARY
NDER-
OLTAGE
OCKOUT
POWER
SCILLATOR
2301-304
T301
BIAS
TRANSFORMER
T302
SECONDARY
UNDERVOLTAGE
LOCKOUT
BIAS
RECTIFIERS
& FILTERS
& REGULATORS
REG + 12
REG - 12
UNREG +5
LOOP
DC OUTPUT
REG + 12 VDC
REG - 12 VDC
REG +5 VDC

Diagram.



E CURRENT PROGRAMMING.
SENSE.

AD

TO GND AND RECONNECT

DUCTS CORP. CORE NO. 596100H03
ERMINALS.

mote Applications
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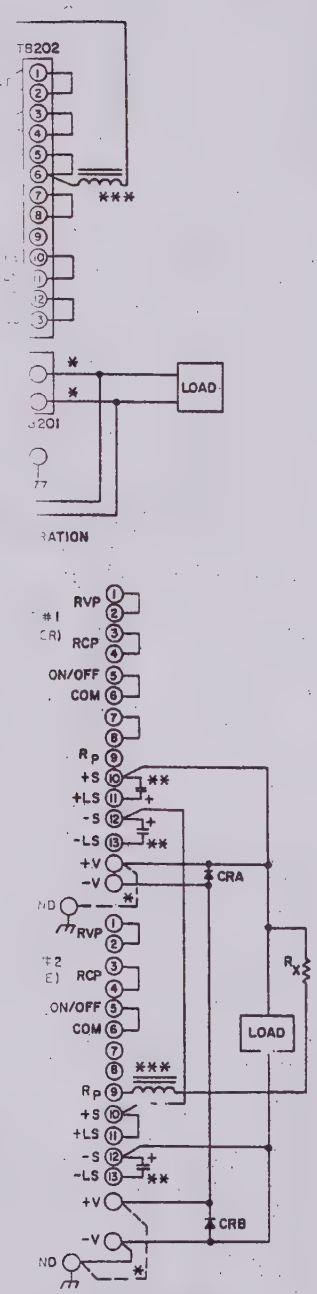


(a) REMOTE SENSING

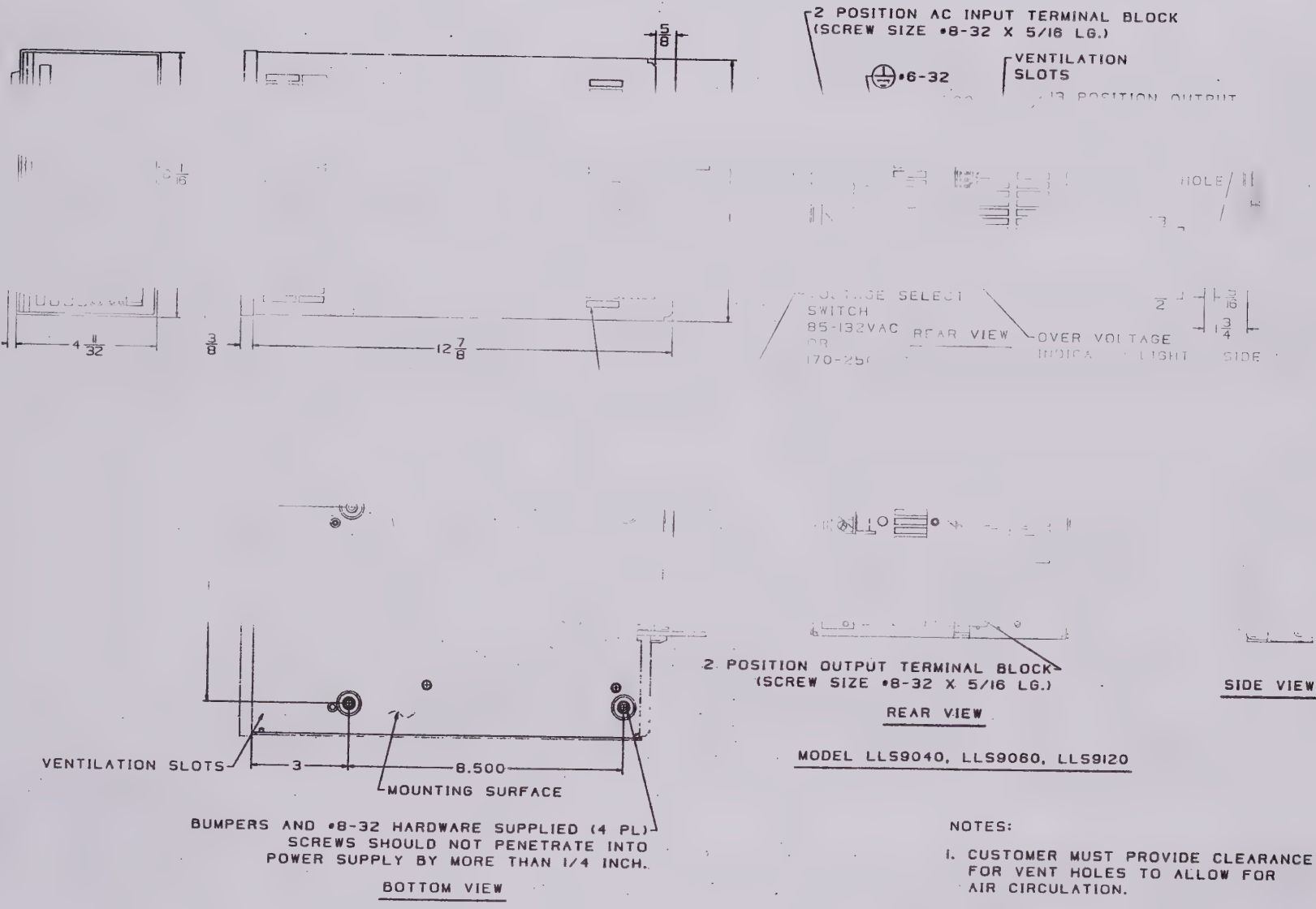
...RIES COMBINATION. TO CHANGE GROUND AS ...D RECONNECT AS DESIRED.

...ED.

... PRODUCTS CORP. CORE NO. 5961001103

...PLY TERMINALS.

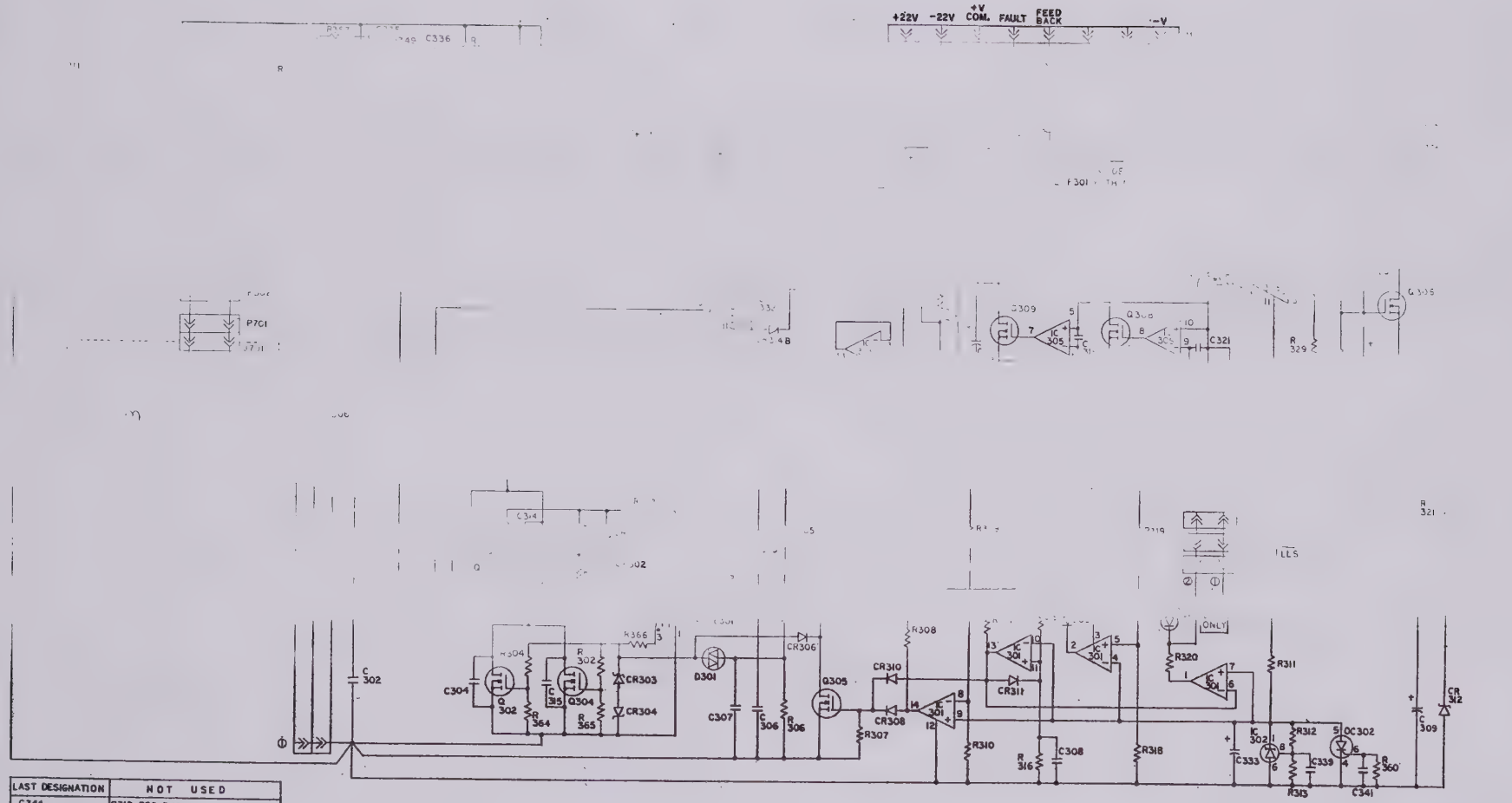
...ure 16. ...ressors in Parallel And Series ...Noise is Required



NOTES:

1. CUSTOMER MUST PROVIDE CLEARANCE FOR VENT HOLES TO ALLOW FOR AIR CIRCULATION.

Outline Drawing

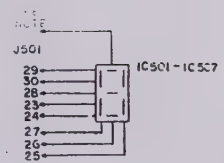


LAST DESIGNATION	NOT USED
C344	C313, 320, 342
CR327	CR313, 322, 323
D301 F301	
IC309	IC308
J307	
OC302	
Q311	Q310
R368	R332, 334, 354, 355, 356, 361, 325
T302 L302	

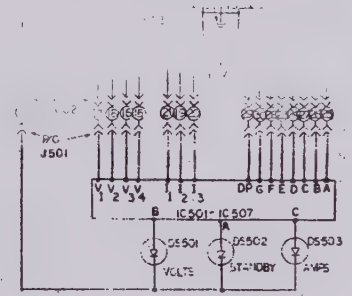
		DRAWN BY	DATE	TITLE:	LAMBDA ELECTRONICS
		M. R. DEFLORA	9/90	LLS/LMS-9000 "C" BOARD SCHEMATIC INCLUDING "G" BOARD	
		CHK.			
		ENGR.			
		APPD.			
USED ON	NEXT ASSY.				
APPLICATION			SCALE		SHEET

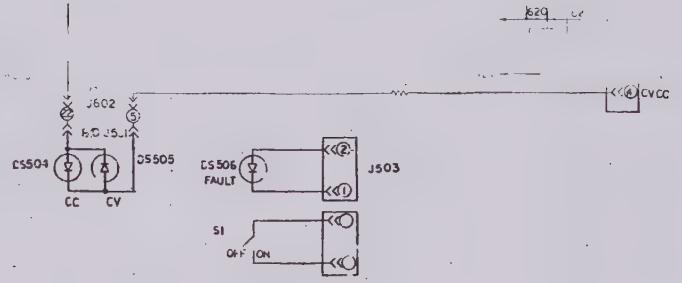
LAMBDA ELECTRONICS — A DIVISION OF — INSTRUMENTS INC

LAMBDA PART NO. & DWG. NO. B



NOTE	J501
IC 501	PIN 17
502	18
503	16
504	15
505	21
506	19
507	20

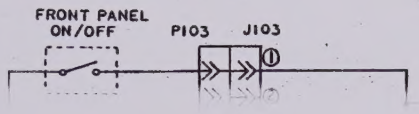


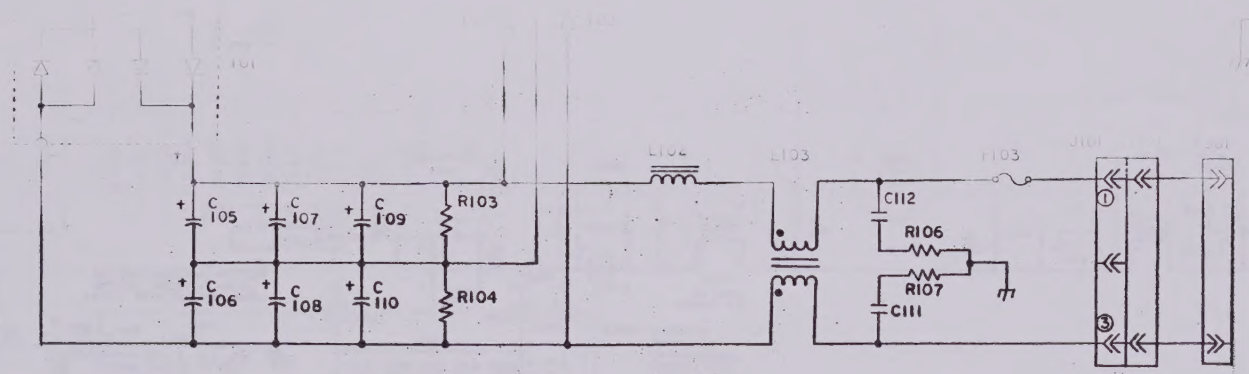


LLS SERIES
FRONT PANEL CIRCUIT
(PRELIMINARY)

LAMBDA ELECTRONICS

N





REQ'D	PART NO.	ITEM	DESCRIPTION	MAT'L OR MFR.	MAT'L SPEC. OR CAT. NO. OR REMARKS
			LIST OF MATERIAL		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND TOLERANCES AS FOLLOWS: DEC. ±.005 FRACTIONS ±1/64 ANGLES ±1/2°

MATERIAL: FINISH:

	SIGNATURE	DATE
DR.	R. DEFLORA	9/90
CHK.		
ENGR.		
APPD.		

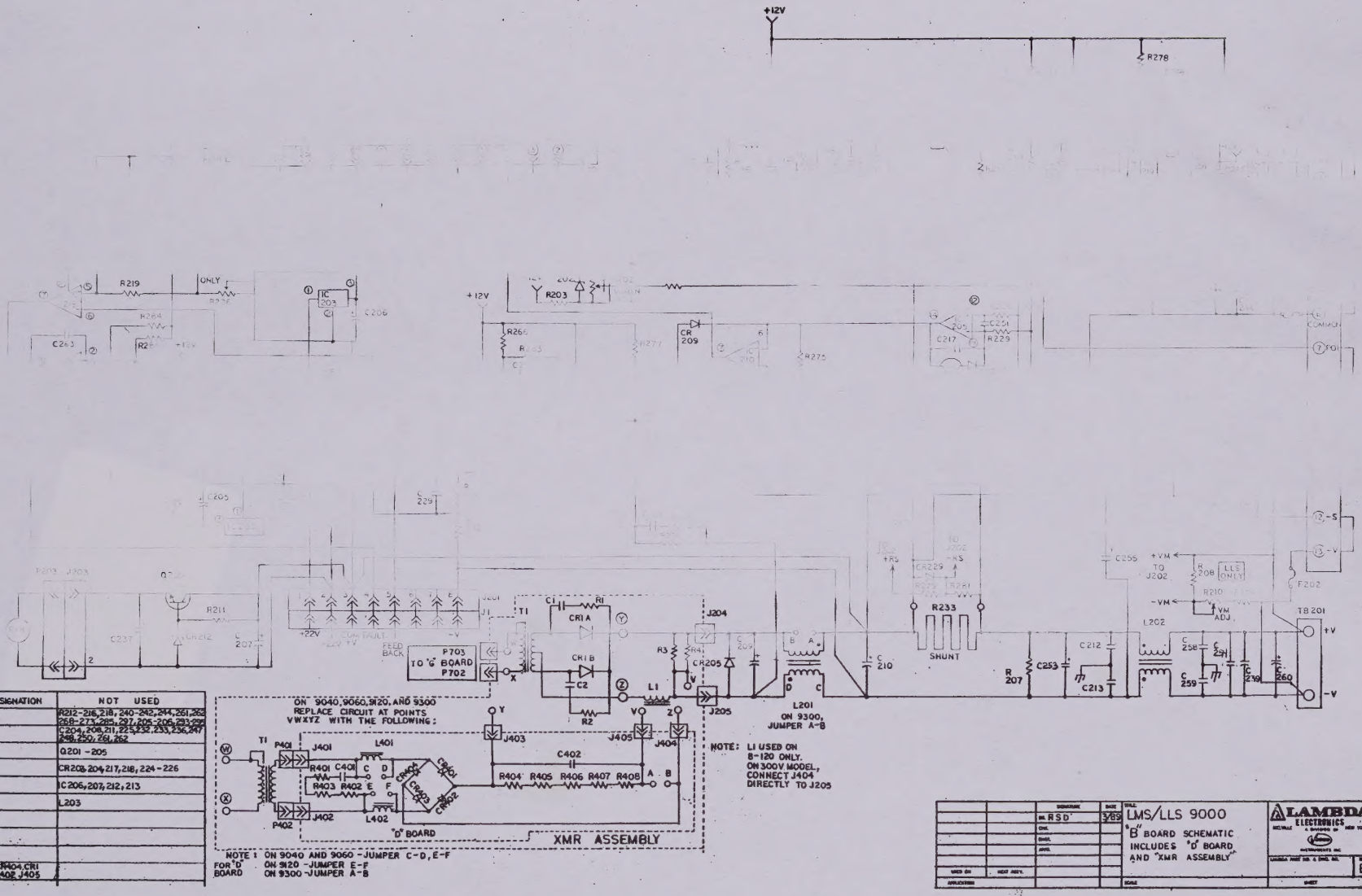
TITLE: LLS/LMS 9000
"A" BOARD SCHEMATIC

LAMBDA ELECTRONICS
MELVILLE, NEW YORK
A DIVISION OF VICOR INSTRUMENTS INC

LAMBDA PART NO. & DWG. NO. | REV. B

DWG SIZE	USED ON	NEXT ASSY.
C	APPLICATION	

SCALE | SHEET



LAST DESIGNATION	NOT USED
R298	R212-216, 218, 240-242, 244, 261, 262, 268-273, 285, 297, 205-206, 293-295
C263	C204, 208, 211, 225, 232, 233, 236, 247, 248, 250, 261, 262
Q209	Q201 - 205
CR229	CR203, 204, 217, 218, 224 - 226
IC219	IC206, 207, 212, 213
L204	L203
J205	
R398, CR404, CR1 P405, L402, J405	

		DESIGNER	DATE	TITLE	LAMBDA ELECTRONICS
		DR. RSD	3/89	LMS/LLS 9000 "B" BOARD SCHEMATIC INCLUDES "D" BOARD AND "XMR ASSEMBLY"	
		CHK.			
		ENGR.			
		APPR.			
USED ON	NEXT ASSY.				
APPLICATION				SCALE	SHEET

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